PC BASED CONTROL SMART HOME SYSTEM USING ZIGBEE WIRELESS TECHNOLOGY

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"I hereby acknowledge that the scope and quality of this thesis is qualified for the award of the Bachelor Degree of Electrical Engineering (Electronics)"

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ABSTRACT

Nowadays, automation system becomes the best solution to overcome human problem which is always forget to switch off the electrical appliances. As we know, there are a lot of types of the automation system which is too expensive and difficult to use. For that reason, an automation system at low cost is built where; user can also program the automated system by their own. The purpose of this project is to design an automation system that can be used to switch ON, OFF and get know STATUS of the electrical appliances by using personal computer. This project focusing developing an automation system with Zigbee wireless technology which is controlled by programmable interface controller (PIC18F14K50). This overall project is divided into two parts. The first part is concern on the hardware development where all electronic components are connected on a single board. Personal computer is the input component while fluorescent lamp and fan are the output component where it's all controlled by controller circuit. Zigbee is a new technology, which has at its centre the goal of eliminating wired connections between home appliances and personal computer. Instead of connecting with wires, every appliance has small transmitters or receivers. The second part is base on software programming to operate the hardware structure. There two types of programs are used for this project. C language is the program used for PIC18F14K50. C language assembles using CCS C Compiler to get the hex file. The hex file loaded into PIC memory using PIC kit 2 burners. C # is another program that used for create GUI for personal computer .In order to achieve better automation system, the security system can be added to this project where more sensor and load can be connected to the PIC serial port. As the result, the PIC capable to control the whole operation of this automation system.

ABSTRAK

Dewasa ini, sistem automatik telah menjadi penyelesaian terbaik bagi mengatasi masalah manusia iaitu selalu terlupa untuk mematikan pekakas elektrik yang telah digunakan apabila meninggalkan sesebuah bilik.Seperti yang kita ketahui, terdapat banyak system automatik dipasaran tetapi harganya terlalu mahal dan sukar digunakan Oleh yang demikian, satu system automatic telah dibangunkan pada kos yang rendah dan mesra pengguna.Tujuan projek ini dilaksanakan adalah untuk membangunkan satu sistem yang boleh menghidupkan dan mematikan pekaka selektrik secara automatik. Projek ini tertumpuk pada membangunkan sistem automatik menggunakan Zigbee teknologi dan PIC18F14K50 sebaga ipengawal pekakas elektrik. Projek in iterbahagi kepada dua bahagian.Bahagian pertama ialah tertumpu kepada pembangunan litar elektronik dimana kesemua komponenkompone nelektronikdisambungberdasarkangambar rajah litar yang dilukis.Bahagian kedua pula tertumpu kepada program untuk mengoperasikan litar elektronik yang telah dibina. Dua jenis program telah diguna untuk menyiapkan system ini iaitu C language untuk PIC18F14K50 dan C# untuk komputer. Program(C language) sistem automatik yang telah disemak dan ditukar kepada kod nombor di pindahkan menggunakan PIC kit 2 burner melalui CCS C Compiler.Bagi menambah baik system automatic ini, lebih banyak sensor boleh disambungkan kepada sistem ini bagi mengawal lebih banyak pekakas elektrik dan boleh digunakan dalam tempat yang lebih luas. Pada kesimpulannya, PIC dapa tmengawal kesemua operasi sistem automatik yang telah dibangunkan.

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LIST OF ABBREVIATIONS

GUI	Graphical User Interface
PDA	Personal Digital Assistant
PIC	Programmable Integral Circuit
USB	Universal Serial Bus
ADC	Analog-to-Digital Converter
PWM	Pulse Width Modulation
BOR	Programmable Brown-out Reset
WDT	Extended Watchdog Timer
ICSP™	In-Circuit Serial Programming™
RF	Radio Frequency
RS 232	Recommended Standard 232
BT	Bluetooth
IDE	Integrated Development Environment
MCU	Multipoint Control Unit (MCU)
IEEE	Institute of Electrical and Electronics Engineers
IRC	Internet Relay Chat
ZB2Ir	Zigbee
ZPA	Zone of Polarizing Activity
WSN	Wireless Sensor Network
PC	Personal Computer
DIP	Dual In-line Parallel
LED	Light-Emitting Diode
UART	Universal Asynchronous Receiver/Transmitter
ADC	Analog-To-Digital Converter
WDT	Watchdog Timer
BOR	Brown Out Reset
PCB	Printed Circuit Board
SPICE	Simulation Program with Integrated Circuit Emphasis

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CHAPTER 1

INTRODUCTION

1.1 Background

Have you ever walked into an empty house where the temperature was at a comfortable level, your dinner was hot and waiting for you, and the TV was on your favourite channel? If this feels like a homely welcome to you then you probably know that this dream is expensive and unrealistic for the common middle class. Currently available technology allows this to be done with timers and/or expensive computers with messy cable connections. This is currently done on a very limited basis, for the rich and disabled. We would like to present our scope on home automation, which is cheaper, wireless and convenient to use.

Imagine controlling your household appliances with your PC (Personal Computer). Today this dream can be realized with Zigbee wireless Technology. Zigbee is a new technology, which has at its centre the goal of eliminating wired connections between computers. Instead of connecting with wires, every appliance has small transmitters or receivers.

The home automation systems provide mutual interoperability between various electronic, electrical, and power devices as well as interactive interface for people to control their operation. These features are very helpful to optimize and to

economize energy consumption whereby saved energy during some few years could make more money than home automation systems implementation cost [1]. These technologies make peoples' life also easier, especially for elderly persons and persons with disabilities. These systems exist of course, but there are many non-interoperable, expensive, and often wired systems. Wiring complicates implementation of the home automation in buildings which are already built, especially in historical ones.

Therefore, my project will be a system where come out with a product which based on PC and Zigbee wireless technology which could effectively communicate with each other to control home devices/appliances.

1.2 Objectives

The objectives of this project are:

i. To develop a smart home system monitoring by Personal Computer.
ii. To design a smart home system based on Zigbee wireless technology and PIC18F14K50.
iii. Develop a system that can reduce the waste of electricity, saves human energy and makes human life easier.

1.3 Scope of Project

The scope of this project is to:

i. To design and develop a PIC18F14K50, Zigbee and relay based home appliances monitoring and status checking system.
ii. To design a GUI for PC for user monitor the system by using Microsoft visual studio C# 2008.

1.4 Problem Statements

The major problem that leads me to develop such a project of smart home system is because of our human being bad attitude itself. Lazy to turn OFF/ON home appliances are common problem among us. Percentage of wastage of high electricity is increasing year by year. A better smart home system is able to overcome such a serious problem.

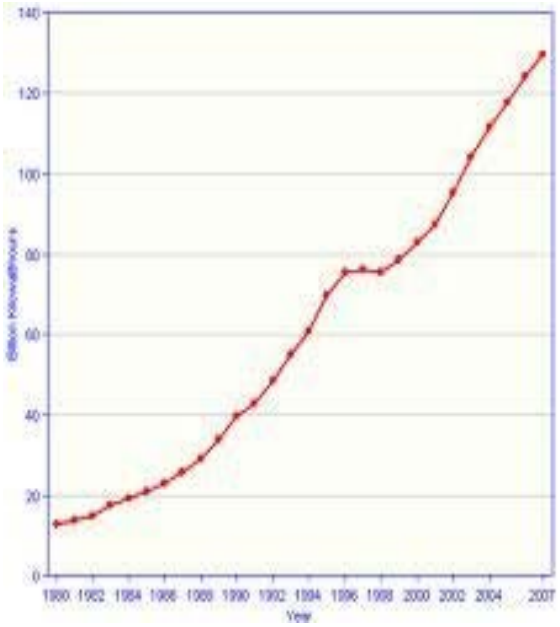

Figure 1.1: electricity wastage in Malaysia (1990-2007)

Secondly, older people are incapable to control home appliances by moving all over their house especially if double story house. Definitely they will suffer to control their home appliances if the house designed control the appliances by switches. This kind of problem can be solvable by developing a system which the home appliances controlling by a PC, because PC is becoming a product where necessary and necessity to our daily life style nowadays. In future PC will use by everyone, not only for communication purpose but also for other important purpose.

Finally there are many smart home system products are selling in the market. Most of them are not suitable and compatible to current lifestyle due to used old technology, complicated wired system, less task compliment and extra. Therefore in my project I'm using latest wireless technology which minimizes the complication of the connection and the product itself. By using PC as an input device, definitely the users feel easy to control their home appliances at anywhere and anytime.

1.5 Thesis Outline

PC based control smart home system using zigbee wireless technology's final thesis is a combination of 5 chapters that contains and elaborates specific topics such as the Introduction, Literature Review, Methodology, Architecture, Result and Analysis, Conclusion.

Chapter 1: Introduction of the project. The explanation for the project will be given in a general term. The objectives of the project will be elaborated. It is followed by the explanation in the scope of project and also the problem statements.

Chapter 2: Literature review for the development of smart home system. This chapter describes the literature review of the project elaborately. Explanation will be focused onsmart home related researched and based on theory and conceptual ideas. Some literature reviews of current existing projects based on smart home system are also be discussed.

.**Chapter 3**: Methodology of the project. This chapter discusses the full methodology of the overall project. Hardware architecture and software implementation of the project. This chapter discusses about the architecture of the project that consists the hardware design and the software implementation.

Chapter 4: Result and Analysis. This chapter explains the result obtained regarding the performance of the system.

Chapter 5: Conclusion. Conclusion and further development or future recommendation that can be applied in this project are being discussed.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Basically this project can be differentiate by 3 main components/ technology such as PC, Zigbee wireless technology and PIC18F14K50 which play an important roles to develop a better, compatible,user friendly and cost efficient smart home system than other existing system .In general, this project consists of two major parts that need to be developed; Hardware and software. For the hardware part it consists of system board which includes PIC18F14K50, Zigbee, relays and some basic electronic components. For this project PIC plays an important role. The function and operation are briefly explained in later chapter.

2.2 Literature Review of Current Existing Projects

This part includes different kind of current existing projects based on smart home system which is done by some researches and University students. Three main

current existing projects based on smart home system of different authors are discussed in this part.

2.2.1 Practical design of intelligent living-space based on Bluetooth System

By:Chun-Liang Hsu, Teng-Yaw Hsu, Kuan-Yen Ho, and Wei-Bin WU from E.E Department of Saint John's University No. 499, Sec. 4, Tang-kin Rd. Taipei County, Taiwan REPUBLIC OF CHINA

In this paper, an intelligent living-space based on blue-tooth system was practically designed and implemented in a living room, which was supported by the Taiwan Education Ministry under "Projects of Improving Teaching Superiority Taiwan colleges", and the whole system was finally proved to be successful with its steady functions. The related techniques developed included software developing of blue-tooth modules, hardware design of interface transition between blue-tooth andRS-232, decoding of message package, pairs matching, and communication mode switching in multi-modules. The study purposes of the system are:-

1. To study the related techniques of Bluetooth modules and its Communication mechanism implemented in an intelligent living-space.
2. To research and develop are mote control system or monitoring system with the Bluetooth communication system.
3. To develop the interface between blue-tooth module and RS232 mounted on any microprocessor or PC.

In this paper the BT combined with microprocessor to become a control module to control home-appliance. Although there were many linking way of BT, this study still tried to keep the flexibility and extending purposes and adapted point-to-point linking mode into practical living –space. We modified the existed appliances and added BT control module to those modified appliance in living-space, after really testifying and operating, the

system proved to be successful and stable. By development of BT module in this study, the whole system could be planted to other remote-control system to engage to data collecting and monitoring, even implementing in industry control [2].

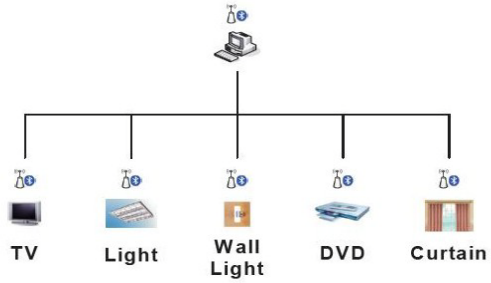

Fig. 5 Structure of system

Figure 2.1: Structure of system

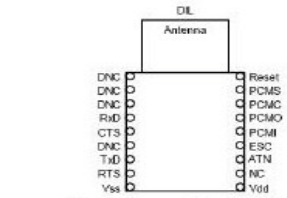

Fig. 9 Pins of link-Matik 2.0

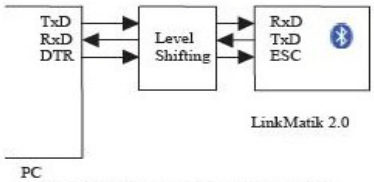

Fig. 10 Diagram of master module

Figure2.2: Diagram of master module

2.2.2 Zigbee based home automation wireless sensor network

By: Michal VARCHOLA, Milos DRUTAROVSKY, Department of Electronics and Multimedia Communications, Technical University of Kosice.

Park Komenského 13, 041 20 Kosice, Slovak Republic, from the paper filed during Aug 25, 2005, with Publication No.: ISSN 1335-8243by, Faculty of Electrical Engineering and Informatics, Technical University of Kosice, Slovak Republic. This paper describes features of the ZigBee standard that is great solution for wireless sensor network. The workplace for wireless sensors networking was prepared and tried out within works at DEMC. This workplace consists of development boards based on perspective ARM and x51 microcontrollers as well as the Free scale's ZigBee development tool chain. Their tool chain includes evaluation hardware, the smart code generator BeeKit and Code Warrior IDE. The HA multiplatform wireless network was based on evaluation hardware, SMAC protocol and proprietary routing algorithm. The interoperability and functionality of used hardware and software were confirmed to achieve sufficient coverage for flat or smaller house. Memory requirement of each MCU platform was also compared. Next step was realization of small ZigBee compliant network using Free scale's tool chain. This tool chain ensures relatively easy network creation and modification. Even though only three nodes were used in the ZigBee network, works at department continue with ambition to realize larger interoperable home automation network based on different manufacturer ZigBee chips.

2.2.3 Home network configuring scheme for all electric appliances using zigbee-based integrated remote controller

By:Kyu Hwang (member of IEEE) ,Dae-Sung Lee and Jin-WookBaek

In this paper, they proposed an integrated remote controller scheme to control electric appliances in the home network with no extra attachment of communication device to the appliances using ZigBee protocol and infrared remote controller technology. Furthermore, ZigBee power adapter was introduced for some appliances which do not have even infrared remote device to be connected in a home network. The proposed system is composed

of IRC, ZB2Ir, and ZPA.IRC is a device to control the appliances and to configure and manage the home network. ZB2Ir controls appliances by converting ZigBee signals to infrared signals. ZPA control son/off switch for the appliances without an infrared remote control scheme. Whereas only one IRC is existed in a network, there can be several ZB2Ir and ZPA.IRC is also a coordinator in the ZigBee network. Where as appliances that is controlled by an infrared remote controller can be child nodes of ZB2Ir, other appliances without an infrared remote control scheme are connected by ZPA. That is,the proposed system enables most of the conventional electric appliances that have no communication devices to participate in a home network. This system can also be connected to another network as a sub-network using ZigBee protocol. It makes home network configuration easily by integrating several networks at home.

Whereas the related research in [2] had to use extra attachment devices to receive ZigBee signals and to convert them into infrared signals in each appliance, the proposed system broadcasts infrared signal to all of the appliances at home using one or several ZB2Ir. All of the consumer appliances receive infrared signals, which are sent from ZB2Ir via IRC, within a scope of the transmission. Therefore there are no hard wiring works whenever users want to attach additional appliances to the network. If the users try to add a new appliance into the network, they just click the add button in the menu of IRC after registering the new infrared remote controller using adding or learning function of IRC. Therefore, it provides high flexibility for the users to configure and manage a home network in order to control all electric appliances in the house.

2.2.4 A zigbee based mesh network for home control system

By: Fei Ding Guangming, Song Jianqing Li and Aiguo Song, Remote Measuring and Control Key Lab of Jiangsu Province, School of Instrument

Science and Engineering Southeast University, Nanjing, Jiangsu, 210096, China

In this paper, they proposed an intelligent home control system based on ZigBee WSN, and implemented two kinds of hardware components: a ZG and some ZR nodes .With the mesh network structure and humanized operation, user in the local place and remote place can control the home devices easily and reliably through the ZG. The implemented home control system is proved to be efficient in performing home monitoring tasks, and it is ready to be used in various home automation application swith little modification [3].

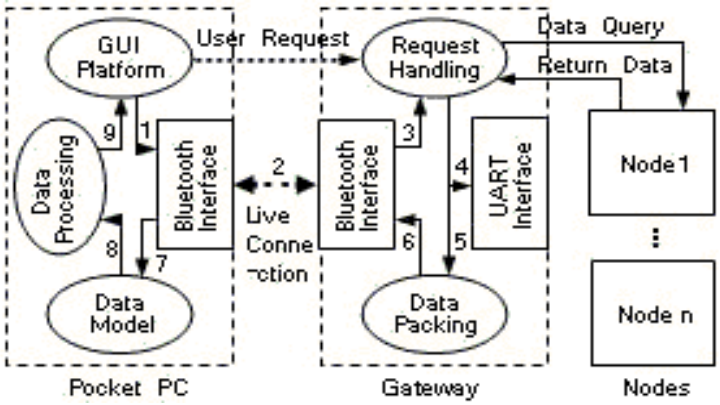

Figure2.3: Real-time data acquisition workflow.